

**DRINKING AND DRIVING:
EVALUATING THE
EFFECTIVENESS OF A CHANGE
IN THE LAW THROUGH A
CONTINUOUS BEHAVIORAL
RISK FACTOR SURVEY**

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DEPARTMENT OF
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MEMORANDUM

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SUBJECT: [REDACTED]
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Running Head: Evaluating Behavioral Change

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**DRINKING AND DRIVING: EVALUATING THE EFFECTIVENESS OF A CHANGE
IN THE LAW THROUGH A CONTINUOUS BEHAVIORAL RISK FACTOR SURVEY**

ABSTRACT

Objective: The aim of this study was to evaluate the impact of state-specific changes in the law on drinking and driving behavior among adults in California. In addition, we were interested in assessing the utility of general population health surveillance data for evaluating broad policy interventions.

Methods: The data are from the Behavioral Risk Factor Surveillance System (BRFSS), a unique, state-based surveillance system, implemented in 1984 and currently active in all 50 states, the District of Columbia, and Puerto Rico. Health-related behavioral data are collected monthly from adults aged 18 years or older in each state. Because of this frequent and continual data collection process, a quasi-experimental approach to the evaluation was used; the so-called interrupted time series analysis or longitudinal impact analysis.

Results: Results showed a statistically significant decrease in the reported behavior after enforcement of the state law, which produced a substantial change in the number of (declared) episodes of drinking and driving. These results were also compared to those from another study conducted in California that examined the impact of changes in the law on alcohol-related traffic accidents. The findings from this study were very consistent with ours; a significant general deterrent effect was associated with enforcement of the law.

Conclusions: Our findings suggest that the intervention (changes in the law regulating drinking and driving) had a positive impact on drinking and driving behavior among adults in California. We also demonstrated that data from a behavioral surveillance system, in this case the BRFSS, were useful to evaluate the impact of such a state policy.

INTRODUCTION

In the United States, driving while under the influence of alcohol remains one of the major causes of crashes and injuries on the road, particularly among young people under 34 years of age.¹ For example in 1994, approximately 41% of the more than 40,000 traffic fatalities were related to alcohol.² During the past decade, some changes in the law regulating drinking and driving were introduced at the state level.³ In this paper, we examine the effectiveness of two different changes introduced in California. The first, which was implemented in January 1990, was a change in the legal definition of driving under the influence of alcohol (DUI) that lowered the allowable blood alcohol limit from 0.10% to 0.08%. The second, implemented six months later, required immediate license suspension for individuals who violated the new limit, i.e., the law was enforced.

The purpose of this study, conducted by the Department of Statistical Science at the University of Padova, in collaboration with the Centers for Disease Control and Prevention (CDC), was to evaluate the impact of these legal changes on adult risk behavior, specifically drinking and driving. Further, we were interested in assessing the utility of general population health surveillance data for evaluating broad policy interventions. The data are from a continuous survey carried out by all states in the US, through the support and coordination of the CDC. We were interested foremost in the substantive problem of assessing the impact of these changes in the law. Additionally, the methodological issue was to investigate whether data from a health surveillance system were useful to evaluate the impact of such a policy intervention.

METHODS

The data are from the Behavioral Risk Factor Surveillance System (BRFSS).⁴ The BRFSS is a unique, state-based surveillance system,⁵ currently active in all 50 states, the District

of Columbia, and Puerto Rico. The system was designed to gather information on health behaviors and preventive practices primarily related to chronic disease and injury. Every month, a representative sample of persons 18 years or older is selected for interview in each participating state and territory. Because the system has been operating for nearly two decades, it approximates a continuous data stream. It is the availability of this continuous data stream that allows us to assess the potential of these data for policy/intervention evaluation. For the current analysis, we used data from the state of California and took into account the three years before and the three years after the intervention, for a total of 20,000 interviews and 84 points of observation (months – from January 1987 to December 1993). Specifically, we examined responses to the following question: "During the past month, how many times have you driven when you've had perhaps too much to drink?"

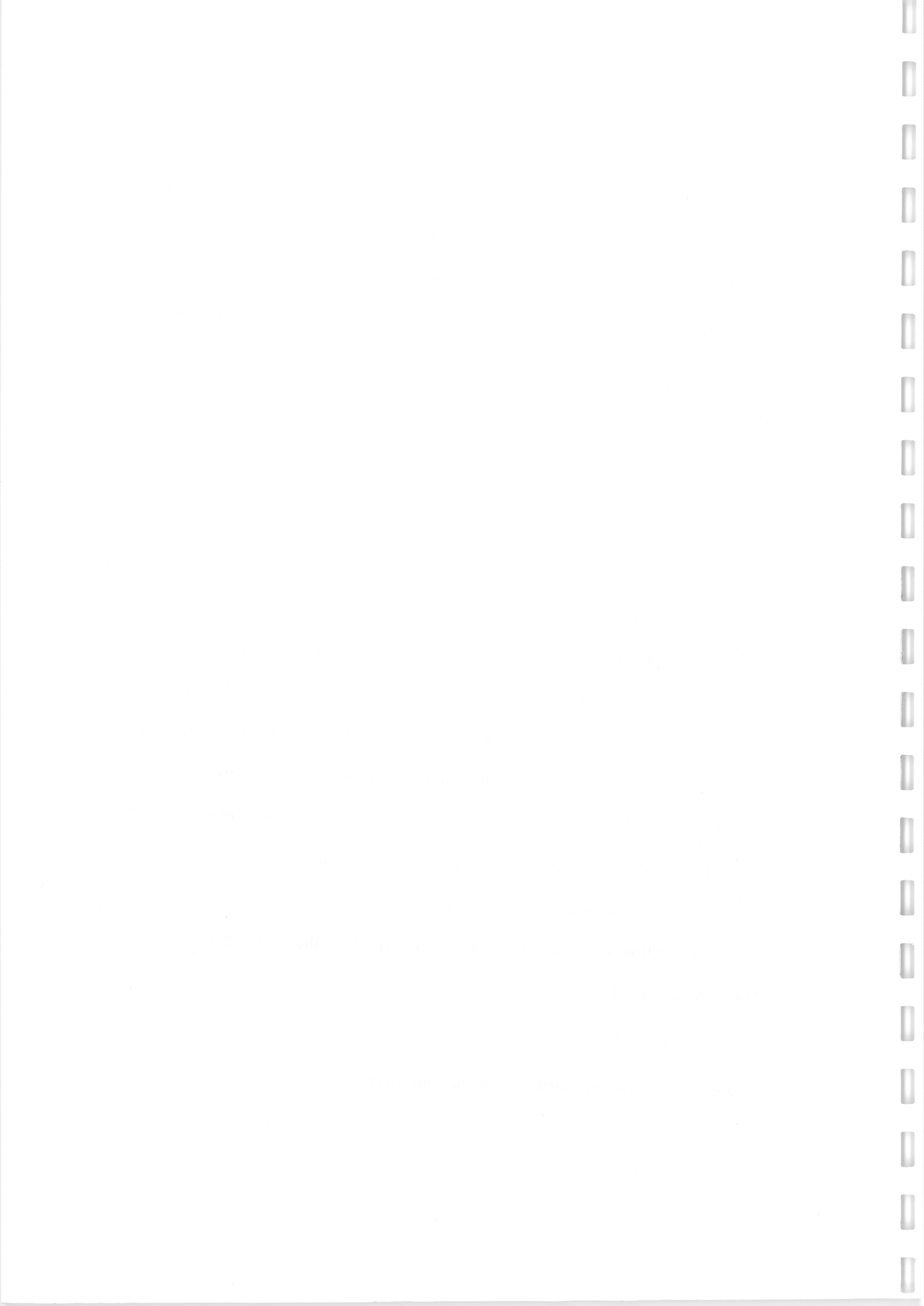
Because the BRFSS was designed to collect data continuously and frequently, a *quasi-experimental* approach to the evaluation was used.⁶⁻⁸ This is the so-called interrupted time series analysis or longitudinal impact analysis, introduced by the work of Box and Tiao.⁹⁻¹¹ Basically, we wanted to observe whether the interventions (the changes in the law) produced a shift in the time series or any other change in its evolution; a method previously employed in studies using BRFSS or other data.¹²⁻¹⁶ This can be examined through a model that considers:

- a stochastic component (usually an ARIMA model) that takes into account all the dependencies among the observations, and
- an intervention component of which we want to evaluate the significance.

Formally, the model is:

$$Y_t = N_t + I_t$$

where N_t is the time series stochastic component,



I_t is the intervention component.

The second component will be equal to zero until the observation corresponds to the intervention, at which point it will assume a non-zero value. If this value is statistically different from zero, then we can conclude that the intervention had a significant impact.

The intervention component can be modeled through three different types of functions following the combination of the effect duration (temporary or permanent) and the way in which it affects the time series (gradually or immediately). Thus, we distinguish:

- an immediate and permanent impact;
- an immediate and temporary impact;
- a gradual and permanent impact.

RESULTS

From analysis of the time series considered, we tested models representing an immediate and permanent impact. Consequently, the model we chose was:

$$Y_t = \omega I_t + N_t$$

where N_t is an ARIMA (p,d,q) (P,D,Q) to be identified, I_t is a step function assuming a value of 1 from the observation corresponding to the intervention or 0 otherwise, and ω is the parameter measuring the entity of the impact on the observed series.

Specifically, we tested three models (Table 1). The first examined the impact of the January 1990 intervention (the reduction of the allowable blood alcohol concentration [BAC] limit from 0.10% to 0.08%). The second model took into account only the July intervention (the law enforcement), while the third model examined the effects of the combination of the

interventions. Theoretically, the most appropriate model for this case is the third one, given the proximity of the two interventions.

In all the three cases, each was a white noise model (i.e., neither autocorrelation, nor trend were detected). Among the three models, the third (the one combining the two interventions) was found to be the best fit. Table 2 reports the numerical results.

The first parameter (ω_1), that considers the entity of the impact of the first intervention (BAC reduction), is positive, i.e., it seems that the introduction of the law has increased the number of people declaring episodes of drinking and driving in the month previous to the interview. However, the parameter is not significant ($p > 0.2$). A possible explanation for the positive value is that the more restricted law (and no enforcement) seems not to change the actual number of episodes of drinking and driving; it seems instead to influence (to a lesser extent) only the number of people considering themselves to have drunk perhaps too much. The other parameter is higher in value ($\hat{\omega}_2 = -0.07145$) and statistically significant. This means that the real change occurred only after enforcement of the law, which produced a substantial change in the number of (declared) episodes of drinking and driving (Figure 1).

Can BRFSS data be used to evaluate the impact of a policy?

The source of the data used for the analysis could raise questions about the results. BRFSS collects information on the major health-related subjects through telephone interviews; respondents spontaneously answer about risk behaviors. A limitation of this type of survey is that it gathers self-reported information. Some behaviors, however, are not easily observable and self-reported information may be the only option. Moreover, the chief advantage of this type of survey is that it is less expensive to design and conduct than observational or record review

surveys. But all these aspects do not ensure the validity of the collected data and the findings that result from the analysis. One way to indirectly assess the validity of the BRFSS data is through a comparison with surveys that ask similar questions, using the same or even different modes of data collection. A number of studies have shown how estimates from BRFSS for selected health-related behaviors compare favorably with similar data from in-person interviews or observations.¹⁷⁻¹⁹

A comparison with "real" data...

We can also indirectly assess the validity of our findings by comparison to another study conducted in California concerning the same evaluation problem.^{20, 21} Using intervention time series analysis, Rogers evaluated the influence of the new DUI laws among the general population of DUI offenders, as measured by the effect on alcohol-related traffic accidents. California Highway Patrol (CHP) provided the accident data from the Integrated Traffic Records System (SWITRS); these data are not self-reported and in view of how they are collected are assumed to be valid.

Results from this evaluation were consistent with those from the current study. A significant general deterrent effect was associated with the implementation of the second law with somewhat less support for such an effect associated with the 0.08% BAC limit law. A larger proportion of observed crash reduction was associated with the timing of the second law than with the lowering of the BAC limit.

Similar results were observed in the series of the number of drinking and driving-related accidents. We considered the rate of alcohol-related accidents on total observed accidents in California, in the same two periods: 34% of traffic accidents were alcohol-related before July

1990, while after the implementation of the second law, this rate decreased to 32% in only 12 months. It would be interesting to analyze the rate variation, during a longer period in time, but at the time of the analysis these data were not available (Table 3 and 4).

More specifically, we went on to compare variations in the level of the BRFSS time series with those that occurred in the CHP data. Using data from July 1989 to June 1990 (pre-intervention period) and data from July 1990 to June 1991 (post-intervention period), we constructed a second BRFSS time series with the monthly average estimated number of positive answers to the alcohol-related question (declared episodes of drinking and driving) for each 1000 persons (Figure 2). The results showed a drastic reduction in the level of the series, an estimated reduction of 78% in the number of drinking and driving episodes (Table 5).

In conclusion, both time series underscore the impact of the implementation of the second law on each outcome (alcohol-related traffic accidents and declared drinking and driving episodes). The effect was a significant decrease in both cases.

DISCUSSION

We acknowledge that two analyses that yield the same results is not a sufficient proof for validity. Nevertheless, we believe that the similarity of the results in both the studies strongly support the validity of our research. More generally, we believe that in many cases it is possible to use behavioral surveillance data for evaluation purposes; the study here is one example. In these analyses, of course, validity issues must be always addressed, but it should be mentioned that quite often data for intervention impact analysis are difficult or impossible to collect, for ethical, feasibility, or cost reasons. Furthermore, when ad hoc data are collected for impact evaluation, selection bias, attrition and other problems intervene, severely jeopardizing the

reliability and the validity of the results. So, the continuous data stream offered by surveillance systems, such as the BRFSS, are quite often a reasonable alternative, certainly much less resource demanding and sometimes as much, or even more valid.

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Table 1. The different ARIMA models

$Y_t = \omega_1 I_{t_1} + N_t$	I_{t_1} is equal to 1 from January 1990
$Y_t = \omega_2 I_{t_2} + N_t$	I_{t_2} is equal to 1 from July 1990.
$Y_t = N_t + \omega_1 I_{t_1} + \omega_2 I_{t_2}$	

Table 2. Parameters indicating the change in law effect on drinking and driving behavior for the best fitting model (Data: California BRFSS, n=20,006)

PARAMETER	VALUE	STD. ERROR	T. RATIO	P-VALUE
ω_1	0.03161	0.02464	1.28	0.204
ω_2	-0.07976	0.02429	-3.28	0.0015

Table 3. Average number of alcohol-related traffic accidents (with at least one person injured)

	Had Been Drinking	Had Not Been Drinking	Total
July 89- June 90	600	1170	1770
July 90- June 91	565	1170	1735

Table 4. Percentage difference in the rate of alcohol-related traffic accidents on the total number of accidents in California.

July 1989 - June 1990	34%
July 1990 - June 1991	32%
Percentage difference	2%

Table 5. Estimated average number of declared drinking and driving episodes per 1000 adults

July 1989 - June 1990	1,865
July 1990 - June 1991	414
Percentage difference between the two periods	77.8%